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solution, where the small hanging drop of saline frequently spread out and the tissue was left closely adherent to the cover slip. In two such cases, and in a similar one in which serum was used, cell movements took place, but the cells which exhibited movements were all in contact with the lower surface of the cover. One case showed nerve fibers. In another interesting case the drop of culture fluid was larger and touched the bottom of the chamber. The piece of tissue sank to the bottom and became adherent, sending out a number of short hyaline protoplasmic processes along the surface of the glass.

These and previous experiments show, then, that the movements of embryonic cells take place when the cells are in contact with a fibrin net, the fibers of a spider web or the surface of glass coverslips and slides, and that they occur in a considerable variety of fluid media. On the other hand when the embryonic tissue is suspended free in a drop of fluid,<sup>\*</sup> no cell movement takes place, though differentiation of tissue may result. In this movement and orientation of the cells we have before us a form of stereotropism, of which, however, the exact nature remains for the present undetermined. Whatever it may prove to be, it can scarcely be doubted that it is an important factor in normal development, influencing the movement and segregation of pigment, mesenchyme and nerve cells at least, and probably also the growth movements of nerve fibers.

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<sup>\*</sup>M. R. and W. H. Lewis (*op. cit.*) state that growth apparently takes place as well in fluid media as in solid, though they admit that the outgrowing cells often creep on the cover glass or the bottom of the dish. I feel confident that careful examination of specimens with reference to this point will show that the growing cells are always in contact with the glass, except that the surface film of the free hanging drop may sometimes act as a substitute for the solid surface, as I have occasionally found to be the case in a series of experiments with tissues of the chick embryo, to be described later.

#### ON THE INCREASE IN OXIDATION IN THE EGG AT THE BEGINNING OF DEVELOPMENT

It was observed by O. Warburg that the oxidation in the sea-urchin's egg is increased when it is fertilized or placed in a hypertonic solution, which induces parthenogenesis. Warburg observed an increase in oxidation in the fertilized egg when placed in pure NaCl solution (which also causes parthenogenesis in the unfertilized egg), but in order to insure the life of the eggs long enough for the experiment he added a trace of NaCN to the NaCl (and to the control).

The addition of NaCN was objected to by Loeb and Wasteneys, who found no increase in oxidation if the cyanide was omitted. Apparently the cyanide, or hydroxyl ions liberated by hydrolysis, had something to do with the result. We found that NaCl increased oxidation in unfertilized eggs about one fourth.

We made similar experiments on unfertilized eggs using an isotonic NaCl solution containing the same hydroxyl ion concentration as the sea water (made by the addition of NaOH). The result was an increase in oxidation in the NaCl solution to double its rate in sea water. In other words, the NaCl solution in the presence of OH-ions causes an increase in oxidation in the unfertilized egg. This was found true also of another parthenogenetic agent.

Microscopic examination showed that the eggs formed "fertilization membranes" in the NaCl solution, and some of them that were returned to sea water after the close of the experiment segmented and produced cilia. In short, the NaCl + OH ions start development and the increased oxidation may be due to the same cause as the increased oxidation in the fertilized egg.

One of the authors has shown an increase in permeability of the egg to ions, at the beginning of development. He suggests that the NaCl solution causes an increased permeability of the egg to OH-ions, and that the latter penetrate the egg and accelerate oxidation. The morphological changes in the egg

may be the result of the increased permeability and oxidation. Perhaps the increased oxidation in fertilized eggs caused by alkaline NaCl is due to still further increase in permeability to OH-ions.

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#### THEORIES OF ELECTRICAL DISCHARGE

THE present attitude of the scientific mind on the one-fluid and the two-fluid theories is amusingly similar to the conditions in the early part of the last century concerning theories of light. The emission theory and the wave theory were both well known. Either could be held by any one who chose to do so. Either would serve as a means for explaining phenomena. The emission theory had the advantage. It had come down through generations from a revered source. There is such a thing as mental inertia. Fresnel and Young learned this. When they fully explained phenomena on the theory of transverse vibrations which could not be explained by the emission theory, it had little effect. They devised new experiments which could not be explained by Newton's theory. They explained the phenomena of Newton's rings on a rational basis. It all counted for nothing. Newton's followers might not be able to explain what it was that happened when light had a fit of easy transmission, or a fit of easy reflection. It was, however, evident that the fits were there, for Newton's rings gave evidence of it.

Every one will of course admit that the two-fluid theory has served a useful purpose. It has, however, also led us astray. It has led us to take a wrong view of phenomena.

When it is said, for example, that hot metals emit positive ions, the idea conveyed is very different from that which would be conveyed by the statement that hot metals take negative corpuscles from the gas molecules which surround them.

If one were to say that householders all over the country are emitting mail-carriers, the idea conveyed would be definite and very mis-

leading. As a matter of fact they are receiving their mail. The mail-carriers simply bridge the gap between the conduction channels along the railways, and the householder.

Of course it is perfectly evident that positive ions such as exist in discharge through gases can not circulate or flow through a copper wire. They simply vibrate to and fro between the terminals. The copper wire is itself a solid aggregation of positive ions. The negative corpuscles pass in rhythmical transfer from molecule to molecule within the wire. All of the phenomena of the vacuum tube and of discharge across air gaps are merely incidental to the condition that at that point the conductor is in gaseous form. The Faraday dark space is simply a region in which molecules, supercharged in the region of negative glow, are urged away from the negative terminal, without appreciable interchange or transfer of the negative corpuscles from molecule to molecule.

The positive or luminous column is a region in which this transfer is going on. These two regions may exist side by side. A small wind-mill made of non-conducting material is then driven in opposite directions in the dark and the luminous columns. The luminous columns are simply "canal rays." The carriers are returning after having delivered all of their supercharge and part of their normal charge.

These dark and luminous regions may, under proper conditions, exist as striations. They are then electrically produced sound waves.

The positive terminal of an influence machine is an exhaust terminal. Negative corpuscles from the surrounding air are drained into it. A disruptive discharge can be made to end in such a drained region, as "sheet lightning," before the positive terminal is reached.

Every lightning discharge which has its terminals in air must at its positive end be a region of "sheet lightning." It is probably often at higher altitudes than the rain-clouds. The negative end is usually within the clouds, and that end is "forked lightning."